

With 8 photos. & 11 plans.

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-FULELI ESCAPE -

T H E S I S

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FULELI ESCAPE.

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Synonyms.

Amirs or Mirs	= former Rulers of Sind
Commissioner-in-Sind	= The chief Revenue Officer in the Province of Sind
Collector	= The head Revenue Officer of a district
Cusecs	= Cubic feet per second
dhoro	= depression - generally applied to an old river channel.
dhund	= depression in which water lodges
duty	= number of acres irrigated by each cusec average discharge of any canal
inundation	= the season when the River is high
inundation canal	= a canal which flows only when its source, the River, is high.
Karia	= a private watercourse
Mir	= a former Ruler of Sind
rabi season	= cold weather season, when crops sown on land flooded during the inundation season are grown.
Rs	= Rupees
Rs 15	= £1 sterling (nearly)
Silt	= fine mud brought down by the River Indus water
Wah	= canal

THE FULELI ESCAPE.

in the Province of Sind, India

The Fuleli Canal, ^A to which the Escape has just been completed, connecting it with the Sea, and turning it from an Inundation Canal, flowing for six months in the year, into a perennial canal, owes its origin to an old branch of the River Indus, which ran in a tortuous course, as shewn on Plan No.1. from A, along the line A C D F E, flowing eventually back into the main channel of the river at the point E. This outlet into the river was closed by a dam in the time of the Mirs, the water being sent forward to feed other canals to the South.

2. The discharge of this old channel was, at one time, only about 1400 cubic feet per second, and it only flowed for a short while, when the river was high. Native landowners, south of the point D, from time to time, continued the channel to G, and eventually to L, making branches, where required for the irrigation of their lands.

3. At the point L, which is 95 miles from the old mouth A, the main canal ends, splitting up into three branches, the Suni Guni, Aliwah large and Sherwah large. These three branches, as about $\frac{1}{200}$ th of the Indus river water consists of silt in suspension, are silted up every year to a depth of several feet, so that they have to be closed every season for some months, in order to clear out this silt.

5. In 1856, a new mouth, direct from the Indus, along the line B C, was excavated, and was designed to discharge 2,365 cubic feet per second, so that the two mouths together would discharge nearly 4000 cusecs. The length of the old mouth to the point C, which is close to the Capital of the District, Hyderabad, is 18 miles, while that of the new mouth, to the same point is only 4 miles.

5. This new mouth, which was afterwards slightly enlarged,

enlarged, proved a great success, and, as the quantity of water used for irrigation increased, the new mouth was scoured out, and eventually the maximum discharge at its head became about 8,000 cusecs, and the combined discharge of the new and old mouths, when the Indus is in flood, is now over 10,000 cusecs, a much greater discharge than that of any other canal in India.

6. One result of this great discharge was, that the low-lying lands in the Bago Tando and Badin Talukas, below mile 58, measuring from the new mouth B, which will hereafter be taken as the mouth of the Fuleli, became flooded annually, the flood water remaining in depressions almost the whole year round, as there was no means of draining it off. Many breaches also occurred in the main canal itself, as well as in its distributaries, and much cultivation was damaged by this flooding.

7. To reduce this great inconvenience, a head regulator was constructed in 1887, at B, the mouth of the Fuleli, by which the quantity of water entering the canal, when the Indus river was in flood, could be controlled, and the flooding at the tail reduced.

8. While the lands at the tail of the Fuleli, in Talukas Bago Tando and Badin, are benefitted by this regulation, the high lands in Talukas Hyderabad, Guni, and Dero Mohbat, which cannot be flooded, however high the Fuleli may be, suffer from want of water.

9. The only remedy for this state of affairs, is in making Escapes, which will allow of the Canal being run at a high level for its whole length, the surplus water in the lower reaches, instead of causing breaches in distributaries, and flooding valuable lands, being run off by these Escapes, on to waste land, into large depressions, or into the sea.

10. As stated by the Superintending Engineer in Sind, in para.3. of his letter of 31st March 1896, to the Secretary to

to Government, Bombay Public Works Department, (Appendix p.20) the question of providing Escapes to the Fuleli, had occupied the attention of probably every engineer who had been in charge of this Canal, and, as far back as 1855, one of the Sind Mirs had given his opinion that before the mouth was improved, the tail should be opened out. As stated in para. 4. of the Superintending Engineer's letter (App. p.21) many schemes were investigated, but were all abandoned as unsuitable.

11. In June 1891, when the Author took charge of the Fuleli Canal District, the Survey for an Escape along the line J K, had been made, and plans were under preparation. As the touring season, which ends in May, was over, the Author could not examine the country towards the tail of the Fuleli, but, in forwarding the plans, and estimate, which amounted to Rs.2,25,000, pointed out in his letter of 8th October, 1891 (App. p.1.) to the Superintending Engineer, that from an examination of the map, the line J.K. did not appear to be a suitable one, as the fall to ~~the~~ point P, in the Dhoru Pura, was only .28 feet per mile (App.p.3), at the same time pointing out that either of the two lines L.M.N. P, or L.U.O. appeared to be decidedly better.

12. On this, the Superintending Engineer did not forward the Project to Government, but returned the plans with his letter of 29th October, 1891. (App. p.4).

13. In the touring season the Superintending Engineer examined the country, and from his examination came to the conclusion (App. p.5.) that a large Escape to the Fuleli was impracticable, and that all that could be done was to open out the tails of some of the branch canals. This was done at a cost of Rs.29,000, but the total quantity of water, which these small Escapes together can carry off is only about 300 cusecs, which makes practically no impression on a canal with a discharge, when in flood, of 10,000 cusecs at its mouth, and over 6,000 cusecs at Mile 58.

58.

Each of these small Escapes is, however, of use to the canal which it serves, and in fact, they simply act as continuations or branches of the canals, as they only flow when the canals flow, while the large escapes will generally be closed in the Inundation season, when all the canals are flowing, and irrigation in full progress, except when required to run off flood water.

14. In his letter of 17th October 1892 (App.p.7.) the Superintending Engineer gives his reasons for abandoning all idea of any independent Escape channel.

15. The Author did not agree with the Superintending Engineer in thinking that a good line for a large Escape could not be found, as shewn in his letter of 8th October 1891 (App.p.1.) already referred to, in which two alternative lines were suggested, and on the first opportunity examined the country at the tail, finding, as he expected, that either of the two lines L.N.P. and L.U.O. would be suitable, but that they would interfere, to some extent, with the irrigation from certain canals. Eventually the Author decided upon the line L.M. between the Suni Guni and the Aliwah large, for several reasons, some of which are given below:-

- (a) It runs nearly South, and almost directly in the same line as the Fuleli, and in the shortest practicable line to the sea, into which surplus water has eventually to be discharged.
- (b) A very good fall of over 9 inches per mile, to the Puran Dhoru, could be obtained.
- (c) No land requires to be put out of cultivation, as all land to the West of the Escape can be irrigated from the Suni Guni, and its branch the Sherwah small (Plan No.1.) and all land to the East from the Aliwah large.

- (d) The length is only $17\frac{1}{4}$ miles, practically the same as J.K. but it runs into the Dhoro Puran, about 20 miles (the distance between K. and M. measured along the Puran bed) nearer the sea, into which the escape water has to flow.

16. On 22nd October 1895 (App.p.9) the Author submitted plans and estimate, amounting to Rs. 2, 49,754 for an Escape along the line L.M. designed as noted below:-

Bed Width.	.	.	.	40 feet
Side Slopes.	.	.	.	1 to 1
Maximum Depth of Water.	.	.	.	10 feet
Calculated Discharge.	.	.	.	1285 cusecs

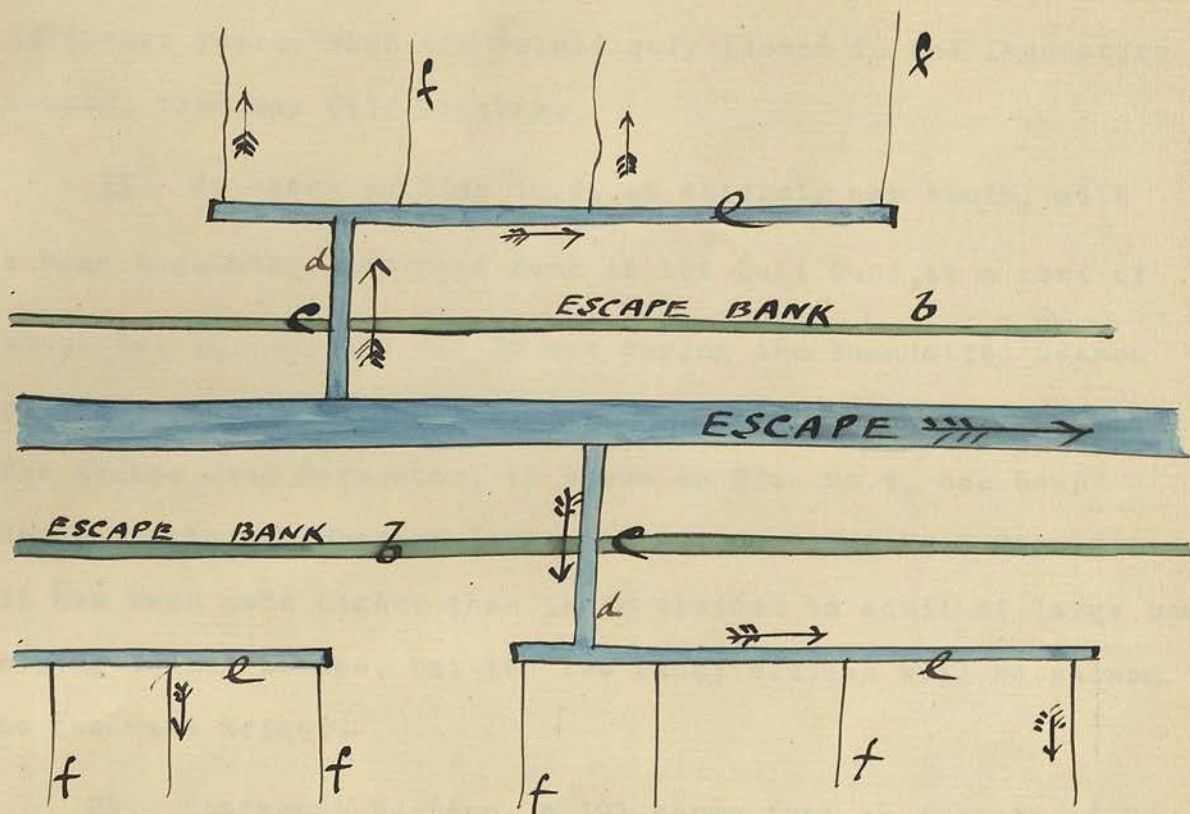
In this letter the reasons for making an Escape were given in full, and in para.17 (App.p.12) a few of the advantages to be derived from it were enumerated. The Escape was opened on the 27th of March, 1900, by Sir Henry James, the Commissioner-in-Sind, and, although the author left the District within 3 weeks of that date, many of the results anticipated had come to pass, for instance:-

- (1) The people and their cattle were getting an unlimited supply of Indus river water, which is much prized by them, as it is infinitely superior to their ordinary well water, which is generally brackish, and which entails labour in drawing.
- (2) The towns noted, need never be surrounded by marshes again, and the loss will only be in fish and ducks, a very small matter, compared with the increase in cultivation and healthiness in the country.
- (3) The higher water can now be taken advantage of in the Hyderabad, Guni and Dero Mohbat Talukas, as excess water which would flood low lands in the Bago Tando and Badin Talukas, can be run down the Fuleli, and off by the Escape, into the sea.
- (4) Within a day or two after the Escape was opened, 3 or 4 feet of silt was scoured out of the Fuleli bed for some miles above the escape mouth (see Plan No.1.)

- 1.) and, as anticipated, this scour was gradually clearing the bed further up the Canal, so that no more clearance will be required in the Fuleli bed, and the supply of water in the Bago Tando and Badin Taluka branch canals will be much improved, owing to the main canal being deepened.
- (5) Boats and steam launches can now ply practically all the year round, in fact, when the Commissioner travelled down the Fuleli in a steam launch, 60 feet in length, to formally open the Escape, there was only a depth of 2.8 feet of water at the Head Regulator; and in the Escape itself, within a few days of opening, boats were unloading Manchester cotton goods, fruits, tobacco and other commodities for villagers near the Escape, and grain was being sent up the canal to Hyderabad, by the same boats.
- (6) The value of a perennial water supply is very great, and within a few years, many pumping engines will be erected along the banks, to lift the water, when it runs at a low level in ^{the} a cold season.

17. The Author, in 1895, in forwarding the Escape Project (App.pp.14-16) referred to the financial prospects of the work, and, although the Escape had only been open for a few weeks when he left India, he saw enough to make him quite certain that the financial results would far exceed those noted in his forwarding letter, and that instead of paying 25% (Rs. 65,000 annually on Rs. 2,53,742) it will soon pay more than 100%. For instance, within 2 or 3 days of opening the Escape, the Author made **e**ight cuts through its banks, and excavated channels, as shewn in sketch, parallel to the Escape, from which the cultivators are allowed to take water:-

water:-



- a. = Escape channel
- b. = Escape banks
- c. = Cuts in banks
- d. = Channels through banks at convenient places
- e. = ~~Equals~~ channels outside escape banks, parallel to escape
- f. = ~~Equals~~ channels excavated by cultivators with sanction of the Engineer

By this means, thousands of acres, much of which was virgin land, was being irrigated and crops sown, before the Author left the District, and the area irrigated was increasing daily. The villagers were returning to several villages, which had been deserted for want of water, as they will now get water every season.

18. On returning to Hyderabad, after opening the Escape, the Author was much gratified by seeing, along both banks of the Fuleli, from mouth to tail, that new Persian wheels had been erected

erected, and that land was being watered, and seed sown, for an extra "Adawah" or Spring crop, which could not be produced in former years, when the Fuleli only flowed in the inundation season, from May till October.

19. As shewn on Plan No.4, an entirely new mouth, with a Head Regulator, has been made to the Suni Guni, at a cost of about Rs. 10,000, and was in use during the inundation season of 1899, when it worked well.

The Escape Head Regulator, as shewn on Plan No.4, has been connected to the Sherwah-large and Aliwah-large Head Regulators. It has been made higher than these sluices to admit of large boats plying in the Escape, but the two canal sluices will be raised to the same height.

20. Statement B. (App. p.19) shows that an average of Rs. 9013 was expended in closing breaches in 1892, 93 and 94, but this sum is only a fraction of the value of labour expended in this work, as many thousands of men who assist in it, only receive food, and many landowners and cultivators send their men to assist, without receiving either food or pay. It can easily be seen, also, what great inconvenience and loss, must be caused by some hundred breaches occurring every season. Besides this, the cultivators were always in a state of uncertainty, as to whether their cultivation would be flooded, whereas now, flood water will be run off into the sea.

21. With his letter of the 21st March 1896 (App.p.20) the Superintending Engineer forwarded the Project to the Government of Bombay, recommending strongly that it should be carried out, and enclosed a Statement C. (App.p.26) giving the discharges of the Fuleli at Hyderabad (C. on Plan No.1.) and of its principal branches, on the 30th August, 1894, from which it will be seen, that, on this date, 6.6 feet was cut off at the Fuleli

Fuleli Head Regulator, in order to reduce the number of breaches in the Fuleli itself, and in its branches. It was necessary to cut off this water, but if there were a sufficient number of Escapes to take off surplus water, the discharge could be increased at the mouth, which would allow of many thousands of acres of high lying land in the Hyderabad, Guni and Dero Mohbat Talukas, being flooded in August and September, when the river is at its highest, which would bring in a very large revenue from "rabi" or cold weather crops, which are grown on land, flooded once or oftener, during the inundation season, or after the inundation, if the land lies low, and can be flooded when the canal water is low.

22. On the 30th August, 1894, the combined discharge of the Fuleli and Old Fuleli at C, was 9,000 cusecs, and of this about 6,500 cusecs reached mile 58 (at page 26). The Escape, which has been constructed, is calculated to discharge 1200 cusecs, so that, when rain falls, and branch canals are partially closed, breaches might still occur between mile 58 and 81, the mouth of the Escape, as between these points, the banks of the Fuleli are low in many places.

23. In 1894 the Author constructed a Regulating Sluice, at a cost of Rs.60,000 across the Fuleli at Mile 46, ^(see photograph) and before leaving the Fuleli District, had made surveys for a 2nd Escape, (G.H. on Plan.No.1) taking off just above this sluice, so that, even when the water in ^{the} Fuleli was low, it could be forced along this Escape, by partially closing this sluice. The 2nd Escape will have exactly the same fall of 1 in 7000, as the Escape already made, and will be similar to it in almost every way. When it is made, there will be little chance of any breaches in the Fuleli.

Besides this, the Author has, for some years past, been raising and strengthening the banks of the canal from Mile 46

46 downwards, in order that it might be able to carry the extra discharge, which can be let in, when the tail Escape is open, so that the banks are becoming safer every year. The Escape (L.M.) has also been constructed so that it can be increased in size, at any time, and its banks will be strengthened every year, by the silt depositing on its wide berms, and the Author anticipates that it will easily discharge more than 1500 cusecs if required.

24. After the Escape Project had been submitted to Government, Colonel Ottley, R.E., then Inspector General for Irrigation in India, visited Sind, in his inspection tour. The Author showed the Escape plans to him, and it was decided in consultation with the Superintending Engineer, to increase the gradient of the bed from 1 in 8000 to 1 in 5714, as, according to certain experiments which were carried out in the Punjab by Mr R. G. Kennedy, now a Superintending Engineer in the Indian Public Works Department, of which an account is given in the Minutes of Proceedings of the Institution of Civil Engineers, Vol. C XIX, Paper 2826, the latter gradient with certain widths and depths of water, would give a velocity, which would neither cause silt to deposit, nor scour to take place.

25. The Author asked for Sanction to make this alteration, which did not materially affect the estimate, in his letter of 29th April 1896, (App. p.27), which explains the reasons for the proposed deviation, which was approved by Government.

As shewn on Plan No.2, the bed of the Escape at its mouth was raised from R.L. 18.33 to 21.00, as the Author considered it advisable to raise the bed of the Fuleli at its tail, and at its tail, the Escape bed was lowered from 6.83 to 4.90.

As the maximum depth of water in the Escape is proposed to be 7 feet, the R.L. of water would be 11.90 at the tail, which is

is .40 of a foot, above the highest known level in the Dhoru Puran; when the Project was submitted.

26. On further consideration, the Author, in his letter of 15th May 1896 (App. p.29) proposed that the gradient should be reduced from 1 in 5714 to 1 in 7000, for reasons given in this letter, but this was not sanctioned.

27. While work was in progress, in 1897, a higher water level occurred in the Dhoru Puran of 14.10, on which the gradient was altered to 1 in 7000, which raised the bed of the Escape at its tail to 7.90 (App. p.20 and Plan No.2) and water level to 7.90 + 7.00 = 14.90, or .80 of a foot above the highest in the Puran. As the R.L. of the average bed of the Puran below the tail of the Escape is between 7.00 and 8.00, it would have been useless to excavate the Escape bed down to 4.90, which would be the R.L. at tail, with the sanctioned gradient of 1 in 5714.

28. Letters of 23rd July 1898, and 26th August 1898 (App. pp. 35 and 36) were written while the Author was on leave, and refer to the proposed method of regulating the Head Sluice, by two rows of vertical needles.

Letter of 12th September 1898, refers to notes which the Author, while on leave, sent to the Superintending Engineer, with suggestions as to the carrying out of certain items of work, in the Escape.

29. After returning to India, the Author, in his letter of 30th March 1899, proposed, for reasons given in this letter, that horizontal baulks should be substituted for the front row of vertical needles, as the latter could not be opened and closed again when the canals are flowing, while the horizontal timbers could be easily worked. This deviation, which, as shewn in the estimate (App. 40 to 48), entailed no extra expense, was sanctioned, and the Author opened and shut the Escape Regulator several times, although no special lifting apparatus has been provided.

A travelling winch, running on rails, supported on the cutwaters

cutwaters of the piers, or some other simple arrangement will eventually be provided if required.

30. Estimates of the different Escape works are given in the Appendix, pages 49 to 86.

- (1) The Abstract estimate, amounting to Rs.2, 53, 742 for the complete work, including Establishment and other charges, is given on pages 49 to 51.
- (2) Estimate No.1. (pp.52-53) amounting to Rs.1,63,205 is an Abstract, made up on the rates at which work has actually been carried out.
- (3) Estimate No.2, for Rs.16,562, (pp.54-72) is for the Head Regulator,-- see Plan No.4.
- (4) Estimate No.3 for Rs.16,604 (pp. 73-79) is the sanctioned estimate for two bridges in Miles 4 and 8,--see Plan No.6, on the Nindoshahr-Lowari and Nindoshahr-Kadhan roads, as shewn on Plan No.1.- Some alterations were made in these bridges during construction, so that the estimate does not correspond exactly with the revised plan, which was made after the bridges were completed.
- (5) Estimate No.4, for Rs.2,300, is for a cheap bridge over a village track, in the 14th Mile.

31. The Escape, as shewn on Plan No.11, cut off several small "Karias" or watercourses from their sources of supply. It was therefore necessary to provide these watercourses with a new feeder, as the whole of the land between the Escape and the Aliwah large (Plan No.1) could not conveniently be irrigated from the Aliwah, owing to large "Dhunds" or depressions lying between them.

32. The Author therefore submitted plans Nos.7 to 11, and an estimate, amounting to Rs.14,083 for a separate canal, taking off from the Aliwah large, and running exactly parallel to the Escape, as shewn on Plan No.11.

33. As there are more than one hundred watercourses cut off

off by the Escape, it would have been very expensive to provide each of them with a masonry sluice at its mouth, which is advisable to prevent waste of water, and to facilitate distribution. The Author therefore provided Six sluices as shewn on Plan No.11, and Six distributing channels from which the cultivators take water, to feed their watercourses.

34. The distribution of water is carried out something in this manner. Distributaries, Nos.1 and 2 are kept fully open for two days every week, the other four being closed, or partially closed, during those days. In the same way Nos.3 and 4 are kept fully open for other 2 days, and 5 and 6 also for two days, so that the cultivators know exactly on which days every week they will be supplied, and make their arrangements accordingly. The small private "Karias" from these distributaries are not provided with masonry sluices at their mouths, but if a breach occurs at the mouth of any of them, the owners of the other "Karias" from the same distributary will force the owner of the "Karia" where the breach has occurred, to close it quickly, and will probably assist him, if it is their interest to do so, the masonry sluice at the mouth of the distributary being closed, while the breach is being repaired.

35. This system of distributaries has proved a very great success. Practically the whole of the cultivation on the Aduwah is rice, which requires much water, and the "duty" on the land watered by this canal, has been increased from less than 30 acres per Cusec to over 45 acres per Cusec, which means that the same quantity of water is irrigating 50 per cent more land. The Collector, who is the chief Revenue Officer in the District, along with some native officials made a special inspection of the rice crops on the Aduwah, and pronounced them to be equal to the best in the District.

36. The Author hopes to see this system introduced

introduced generally in Sind, even on old canals, as it will lead to an enormous increase of cultivation, and consequently of Revenue, without the expenditure of any more water.

37. The designs of the Aduwah Works are shewn on Plans Nos. 7 to 11, and the corresponding estimates in Appendix, pages 87 to 125.

Some photographs, taken by the Author, accompany the plans.

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Executive Engineer,

FULELI CANALS DISTRICT.

EDINBURGH.

1st February, 1901.